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ICEXPOSE:ICY EXPOSURE OF MICROORGANISMS

Abstract

The cold, arid, remotely located and perennially ice covered environment of the Antarctic ice sheet is the most hostile place on Earth.It has long been considered an analogue to how life might persist in the frozen landscape of the major Astrobiological targets of our solar system such as Mars or the Jupiter's ice-covered moon Europa. In the frame of the ICExPOSE project presented here, the parameters outside the Antarctic Concordia station are utilized as a testbed for performed or planned long-duration space flights and to study the survivability of selected test organisms in an extremely cold (with temperature swings) and highly variable UV environment. The most likely terrestrial organisms to endure such an excursion are extremely tolerant and/or (multi-) resistant microbes-extremophiles- that have evolved mechanisms to withstand such severe conditions. The survivability of a variety of human-, space-flight and extreme-associated microorganisms from all three domains of life (plus viruses) will be investigated using a multiuser exposure facility called EXPOSE that has already been successfully flown on ISS for space exposure durations of up to 2 years. The EXPOSE Mission Ground Reference (MGR) trays are still available and will be reused to accommodate the samples for passive exposure. Microbiological response to single and combined extraterrestrial conditions including simulations of astrobiological relevant environments, like simulated Martian atmospheric conditions, will be tested. The scientific questions addressed in ICEXPOSE are: how is the survival of human-associated and Polar Regions- derived microorganisms compared to (other) environmental extremophilic microorganisms; which physiological state (i.e., cells, spores or colony/biofilms) harbors the weakest or strongest viability and/or mutagenicity detectable after exposure; what type of morphologic and molecular changes can be identified and to which extent does the exposure conditions (e.g. UV-exposed versus UV-shielded) influence the microbial physiology (e.g. pathogenicity, antibiotic resistance, and metabolism) of the exposed species. The results of the ICExPOSE experiment will provide valuable information on: the definition of the physical-chemical limits of life as well as the potential habitability of other planetary bodies; the assessment of the risk of microbial contamination inside human inhabited confined areas and consequent challenges for human health; how to better monitor and control microbial contamination in spaceflight environments, as a key-factor for the success of future space exploration missions; whether specific microorganisms pose possible forward contamination risks that could impact planetary protection policy and will provide complementary results

for the two selected future ESA space experiments MEXEM and IceCold.